

# ***DOE/CRN MICROTURBINE EVALUATION PROGRAM***

***Edward A. Torrero  
Cooperative Research Network  
National Rural Electric Cooperative Association  
Arlington, VA***

## ***ELECTRIC COOPERATIVES***

- **1000 co-ops in 47 states**
- **10% power supply, 30 GW**
- **45% distribution lines, 75% land mass**
- **13 million service connections, 30 million customers**
- **60% residential, 35% commercial/industrial**

# **NRECA**

***690 Employees at NRECA Supporting 60,000 Co-op Employees***

- **Legislative, Policy & Communications**
- **Retirement, Health & Dental Insurance**
- **Homestead Mutual Funds**
- **Education/Training to >20,000 registrants**
- **Technical & Safety Programs**
- **International Program in 15 Countries Bringing Electricity to 30 Million Customers**
- **CRN - \$3 Million/Year for New Projects**

# ***TYPICAL MICROTURBINE USES***

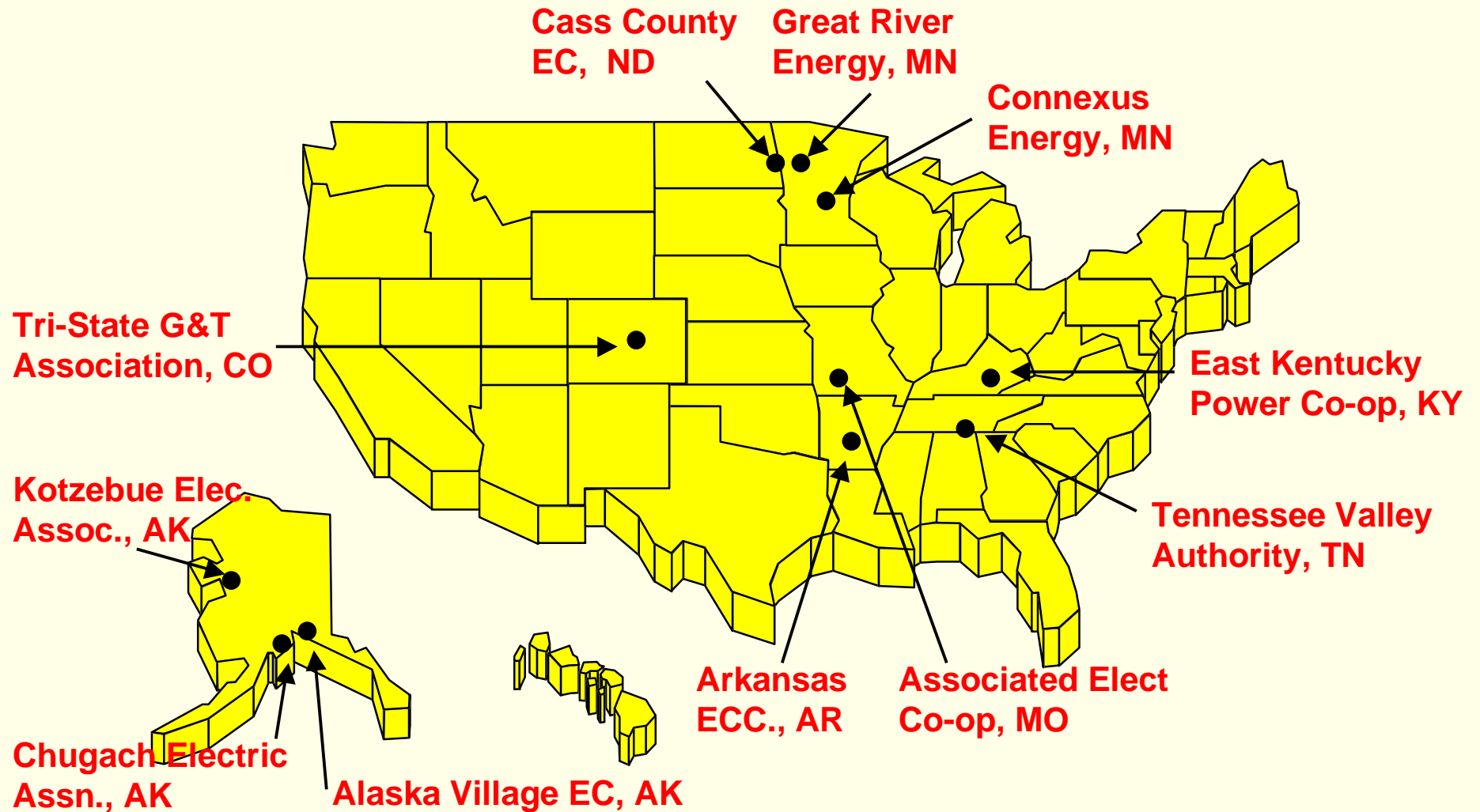
<b><i>Location</i></b>	<b><i>Owner</i></b>	<b><i>Uses</i></b>
<b>Utility facilities</b>	<b>Utility</b>	<b>Grid Peaking Support</b>
		<b>Baseload Capacity Enhancement</b>
<b>Customer Sites</b>	<b>Utility*</b>	<b>Grid Peaking Support</b>
		<b>Grid Outage Backup for Customer</b>
	<b>Customer*</b>	<b>Baseload</b>
		<b>Demand Reduction by Customer</b>
		<b>Grid-Dispatched Peaking Support</b>
		<b>Grid Outage Backup by Customer</b>

**\*May include thermal recovery to increase energy efficiency**

## ***PROGRAM OBJECTIVES***

- **Collect test and operation information on installation and performance by NRECA participants**
- **Identify developmental needs re: permitting, interconnection and building code compliance**
- **Identify developmental needs re: technology, maintenance and operation**
- **Provide technology baseline to benchmark future improvements**

# PARTICIPATING CO-OPS



## ***SITES BEING CONSIDERED***

- **Office/Warehouse**
- **Hospital**
- **Hotels & Motels**
- **Power Plants**
- **Nursing Homes**
- **Colleges & Schools**
- **Fast-food & Convenience Stores**
- **Mining Operations**
- **Manufacturing Plants**
- **Remote Village Settings**

## ***PROGRAM FUNDING & EXPENSES***

### **FUNDING**

- EPRI/CRN        \$400,000
- CRN                100,000
- CO-OPS           650,000
- DOE                200,000

### **EXPENSES**

- Installation, incl.  
  equipment        \$725,000
- 12-mo. Optn.      515,000
- Overheads         110,000

Total    =    \$1,350,000

## ***MICROTURBINES***

<b><i>Number/Model</i></b>		<b><i>Installation</i></b>
<b>Two</b>	<b>75 kW Allied-Signal/Honeywell</b>	<b>2000-2001</b>
<b>Five</b>	<b>28 kW Capstone</b>	<b>2000</b>
<b>Three</b>	<b>45+ kW Elliott/GE</b>	<b>2000-2001</b>
<b>One</b>	<b>70 kW NREC Ingersoll-Rand</b>	<b>2001</b>

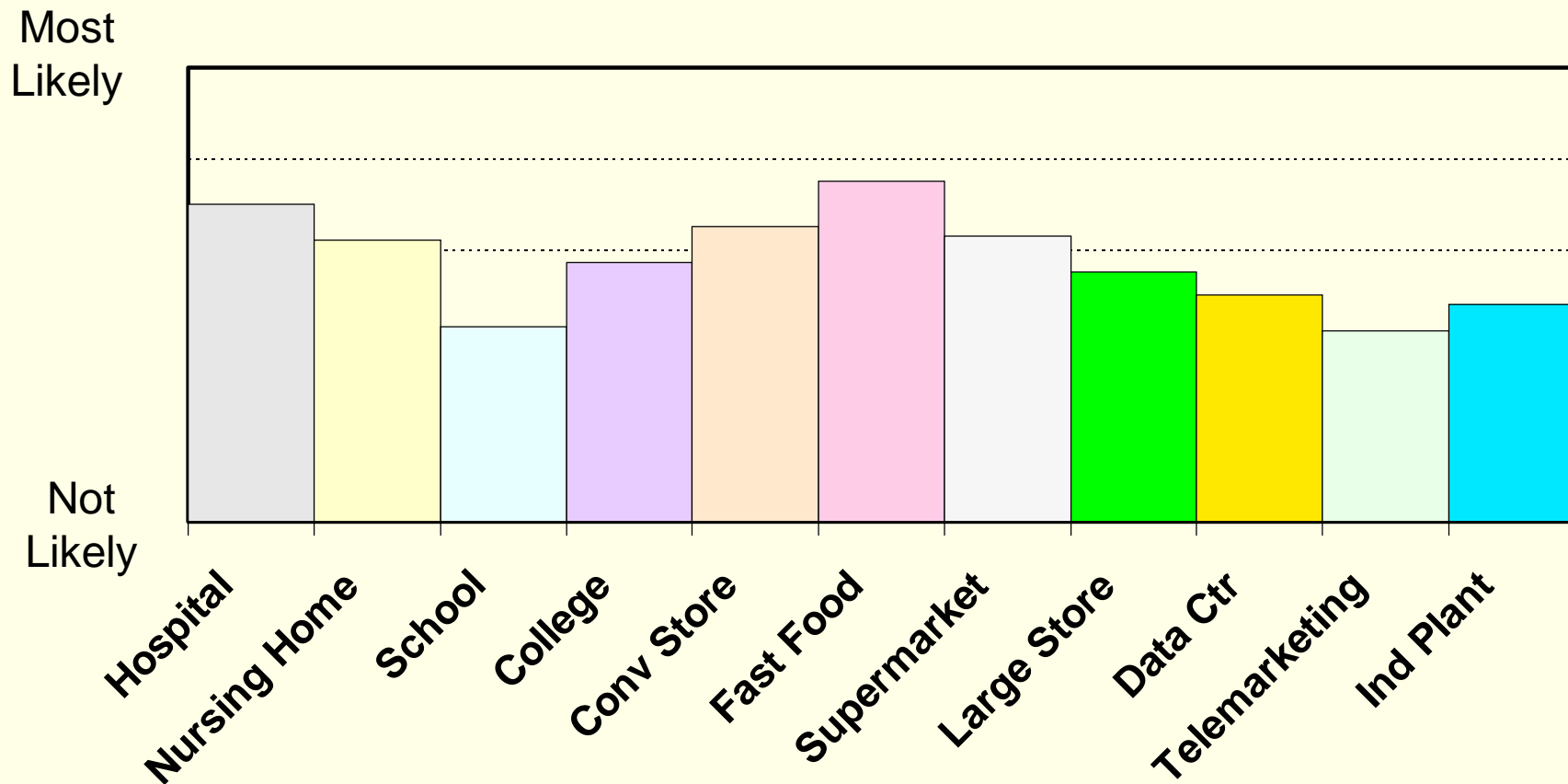
## ***REQUIRED ATTRIBUTES***

- **Recuperator to recycle exhaust heat**
- **Compressor for natural gas**
- **Grid parallel with dispatch control**
- **Grid independent with black start for customer backup**
- **Fuel options: natural gas, propane and fuel oil**
- **Thermal recovery**

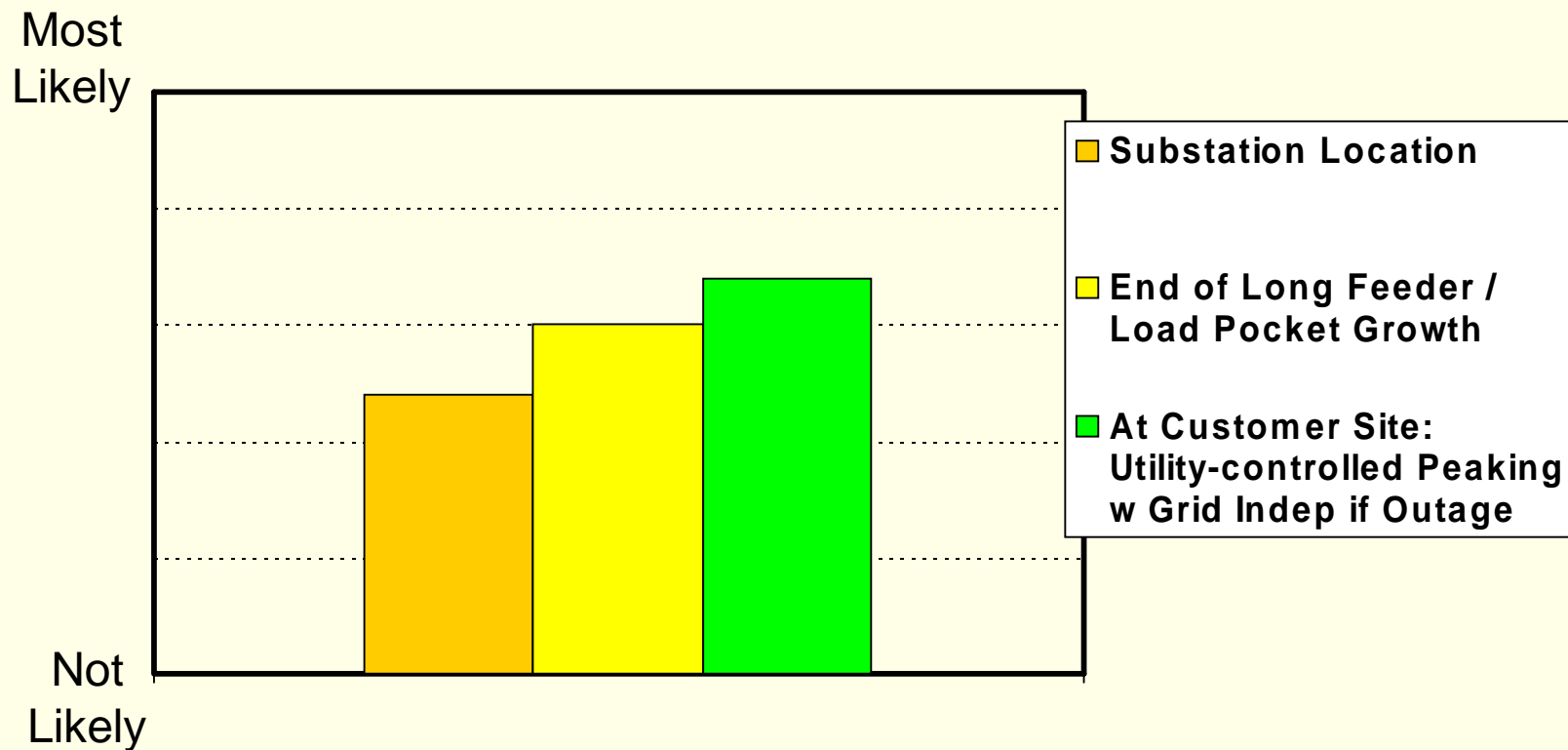
## ***DEMONSTRATION FEATURES***

- **Low pressure natural gas**
- **Fuel oil**
- **Grid-independent operation**
- **Thermal recovery**
- **Simulation of remote grid dispatch**
- **Simulation of SCADA integration/interconnection**

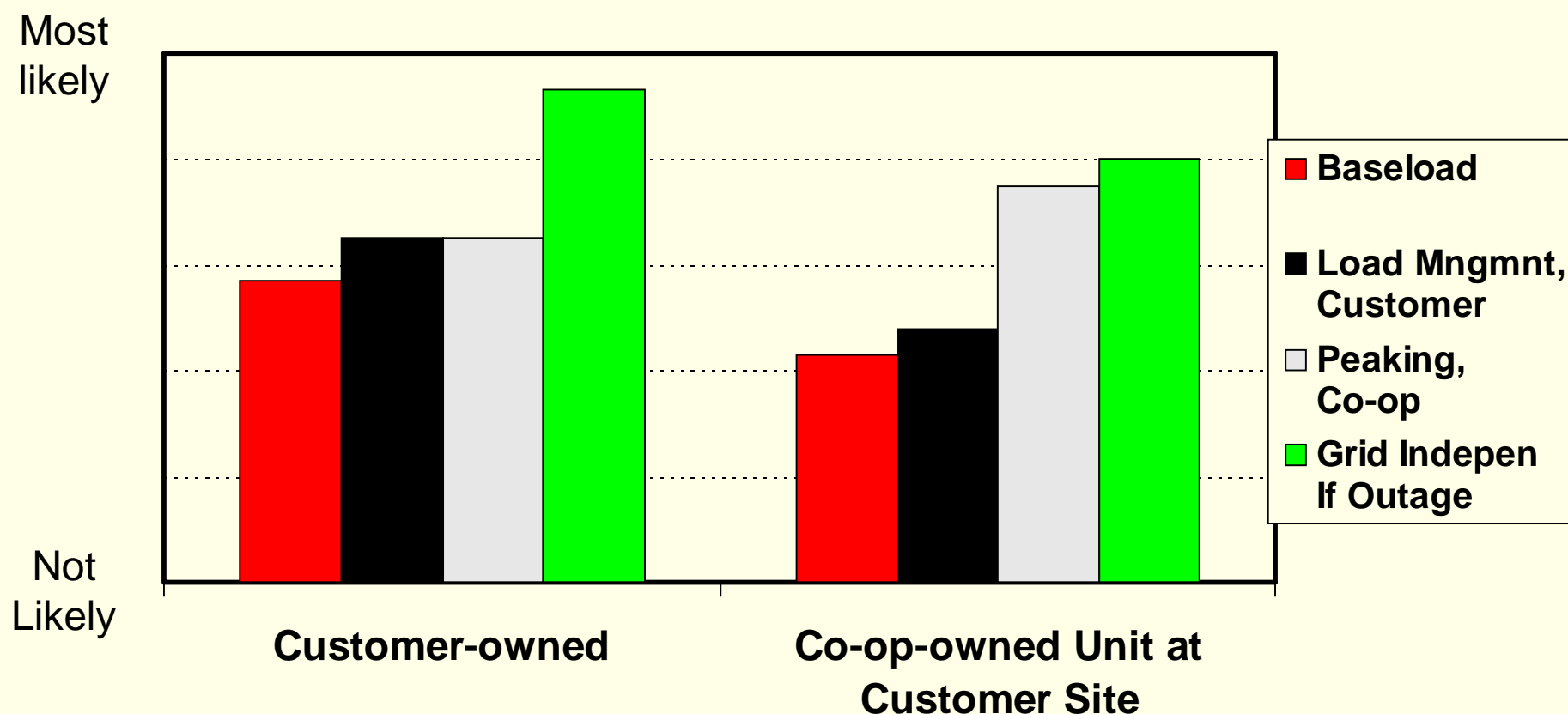
# ***ASSESSMENT: LIKELY MKTS FOR CUSTOMER-OWNED UNITS***



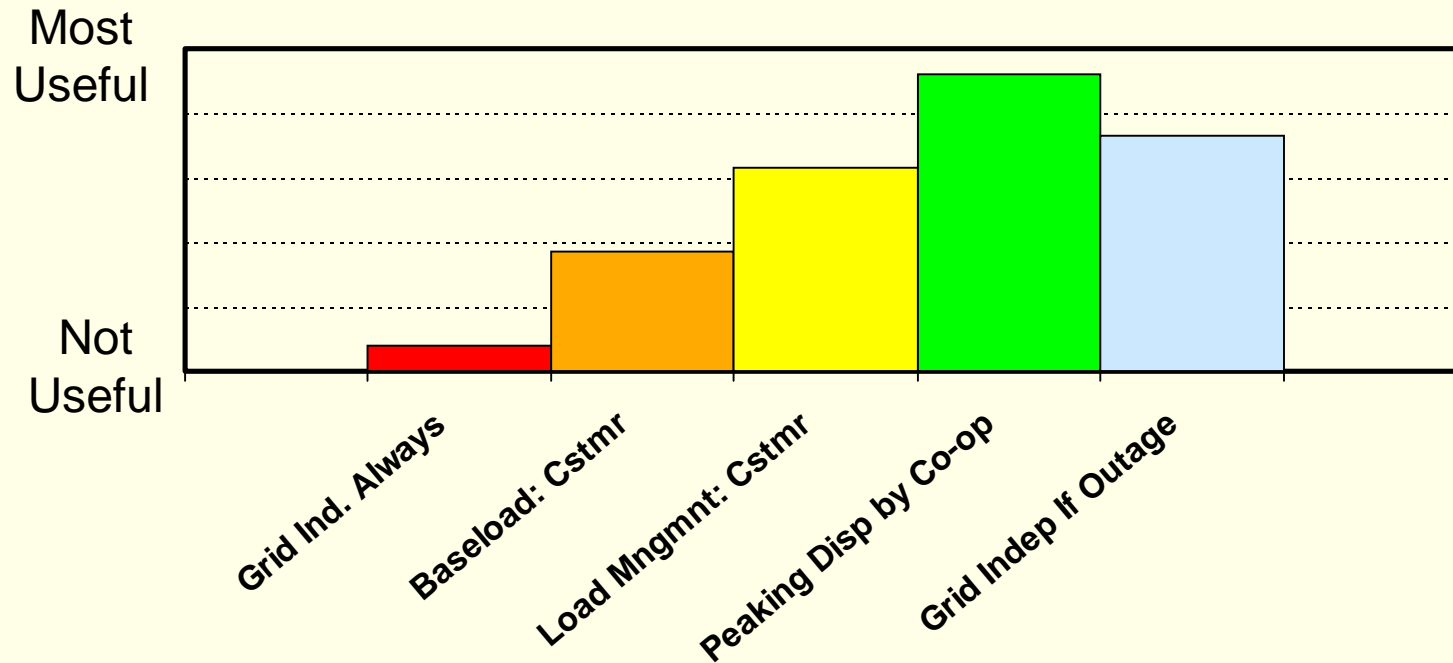
# ***LIKELY LOCATIONS FOR CO-OP-OWNED MICROTURBINES***



# ***ANTICIPATED OPERATING PATTERNS FOR UNITS AT CUSTOMER SITE***



# ***ASSESSED VALUE OF OPERATING PATTERNS TO CO-OP OR GRID***



# ***POTENTIAL MICROTURBINE GOALS***

## ***Target Threshold Values for Enhanced Applicability***

### **Fuel/Maintenance**

- **3.6 ¢/kWh Customer Baseload**
- **6.1 ¢/kWh Customer Load Management**
- **5.7 ¢/kWh Co-op Peaking at customer site**

### **Installed Costs**

- **\$420 per kW installed cost**
- **No backup or standby charge for customer installation**

***Applicable natural gas pricing was assessed to range at \$2.50 to \$4.50 per million BTU or thousand cubic feet.***

## ***CO-OP MICROTURBINE WISH LIST***

- **Demonstrated reliability**
- **Maintenance track record**
- **Increased kW output**
- **Reduced capital costs**
- **Improved efficiencies**
- **Improved enclosures for cold weather regions**
- **Standardized heat exchangers**
- **Reduced use of external transformers**

# ***PROGRAM TASKS***

- **Characterize Site Applications**
- **Develop Test/Instrumentation Plan**
- **Document Installation**
- **Document Performance and Field Experience**
- **Complete Final Report**

# ***PROGRAM DELIVERABLES***

- 3 Test & Instrumentation Plan**
- 3 Site Characterization Reports**
- ! Commissioning Test Reports**
- ! Completion of 8,000 hours of Staged Tests**
- ! Final Report**